REMARKS

The present response is intended to be fully responsive to all points of rejection raised by the Examiner and is believed to place the application in condition for allowance. Favorable reconsideration and allowance of the application is respectfully requested.

Claims 1-35 are pending in this case. Claims 1-35 have been rejected under 35 U.S.C. § 35 U.S.C. § 103(a). Independent claims 1, 14 and dependent claims 2, 6, 15 have been amended.

Response to 35 U.S.C. § 103(a) Rejections

Claims 1-11, 14-21, 24-33:

The Examiner rejected claims 1-11, 14-21, 24-33 under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,181,258 ("Summers et al.") in view of U.S. Patent No. 7,046,792 ("Harrow et al."). To reject the claims as obvious under 35 U.S.C. §103(a) there must be some suggestion or motivation, either in the references themselves or in the prior art, to modify or combine teachings. Furthermore, the prior art references must teach all the claimed limitations. Applicant has reviewed the cited art and respectfully submits that the art fails to disclose or suggest the Applicant's claimed invention, and fails to teach each and every element and limitation of the claims rejected herein. Specifically, Applicant respectfully submits that the prior art fails to disclose or suggest at least a method of **estimating modulation noise** that includes the steps of averaging phase error samples, generating a normalized phase error which is then compared to a threshold, and generating a failure indication if the number of threshold crossings exceeds a maximum. Therefore, Applicant respectfully traverses the rejections and requests favorable reconsideration.

While continuing to traverse the Examiner's rejections, Applicant, in order to expedite the prosecution, has chosen to clarify and emphasize the crucial distinctions between the present

invention and the devices of the patents cited by the Examiner. Specifically, representative claim 1 has been amended to include a method of estimating modulation noise for use in a transmitter having a phase locked loop, said method comprising the steps of averaging phase error samples produced by said phase locked loop, subtracting said average from a current phase error sample to yield a normalized phase error, generating an exception event if said normalized phase error exceeds a threshold, and repeating said steps of averaging, subtracting and generating over a period of time and outputting a failure indication if the number of exception events exceeds a maximum criteria and a pass indication otherwise.

Summers et al. teaches a receiver capable of receiving in parallel data transmitted at arbitrary frequencies within a radio channel. The receiver includes a radio frequency (RF) front end to convert an RF signal to a digitized signal, a Fast Fourier Transform (FFT) generator coupled to the RF front-end to separate the digitized signal into a plurality of sub-channels, a bank of phase locked loops (PLLs) coupled to the FFT generator, each PLL operating on a sub-channel with a sub-channel center, and a flag detector coupled to the bank of PLLs to detect variations from the sub-channel center and to recover the usage data transmitted from the end-point.

Harrow et al. teaches the amplitudes of a signal on the microphone input of a telephone and a signal on the line input of the telephone are compared with each other and with two thresholds. The comparisons are sampled and the samples control an up-down counter. The count in the counter is compared with two thresholds and the results of the comparisons are used to control at least two accumulators. A first accumulator counts consecutive comparisons having the same result and a second accumulator counts up or down in accordance with the comparisons. The counts in the first and second accumulators are logically analyzed to

determine whether to receive or transmit. A plurality of samples defines a window, at the end of which the up-down counter is reset. The accumulators store data from a plurality of windows.

It is submitted that the mechanism of Summers et al. is intended for use in a receiver for the purposes of **normal receiver demodulation**. The phase error generated by the phase detector 144 is first adjusted by a phase adjustment block 158 which in turn drives an absolute phase angle determination block 160. A moving average block 162 calculates a mean phase error from the absolute phase angle which is then input to a comparator and compared to a threshold. The thresholding performed, however, is for **purposes of generating a lock detect indication** and **not** for purposes of noise measurement. The lock detect signal is then input to a state machine which provides feedback to the phase adjustment block 158, loop filter 148 and the switch 150. Thus, the moving average is done on the absolute phase angle in order to generate a lock detect for the PLL in demodulating the received data. See col. 7, line 49 to col. 8, line 14.

In contrast, the present invention is a mechanism for **estimating the phase modulation noise** of an oscillator, such as used in a transmitter. The phase noise estimation mechanism is used in the transmitter (or receiver), **not** for normal transmit or receive operations, **but rather for testing or performance monitoring purposes**. The mechanism is intended for testing purposes where it is required to ensure that the transmitter (or receiver) of a radio comply with the modulation quality or phase noise requirements of a communications standard, such as Bluetooth or GSM.

Modulation inaccuracies and phase noise on the oscillator used to generate the carrier frequency (in a transmitter for example) translate, after frequency demodulation at the receiver, to distortion and additive baseband noise, which could degrade the receiver's performance. For this reason, transmitters must be tested for compliance against the defined modulation quality

criteria as specified by the relevant standard (e.g., Bluetooth, GSM, etc.), which specifies the permitted limits on the amount of distortion and noise in the TX circuitry.

[001] In a two-point modulation injection transmitter, such as described in the present invention, assuming a stable reference crystal (e.g., DCXO), the phase error at the output of the phase detector in the PLL in the transmitter, corresponds to the undesirable portion (i.e. noise and modulation errors) of the modulation. Further, since the modulation errors and noise at the RF output (within a certain bandwidth) correspond to the phase error, the invention estimates their statistics via measurements of the phase error signal within the PLL. The mechanism of the present invention serves to determine compliance of the device with the relevant specifications **without** requiring statistical estimations and calculations of high complexity. Thus, the invention **eliminates** the requirement of performing complex calculations of the variance of the noise (which represents both its power and its probability to exceed the value for which an exception event would occur). Calculating the variance normally entails computing the mean of the squares of differences between the sampled values and their average, which is very costly in terms of required processing resources.

[002] Instead, the mechanism of the present inventions **estimates** the level of noise by **counting the number of times** (called exceptions) the normalized phase error crosses a threshold within a predefined period of time. The value of the count corresponds to the noise power via the distribution function of the noise. If the count exceeds a predefined (software configurable) maximum, the device under test fails, otherwise it passes. The maximum number of exceptions permitted is set to correspond to the modulation quality requirement of the particular standard. Thus, the invention trades complex computations of variance and other statistics on the phase error signal for a relatively simple thresholding and counting mechanism that is much easier and

cheaper to implement. These features are neither taught nor suggested by the Summers et al. or Harrow et al. references cited by the Examiner.

Applicant respectfully submits that the Examiner has failed to show that one of ordinary skill in the art would have been motivated to modify Summers et al. in view of Harrow et al. to arrive at the claimed invention because there is no suggestion made by Summers et al. or Harrow et al. to perform **modulation noise measurements** in a transmitter by counting the number of times the normalized phase error within a PLL crosses a threshold. It is therefore submitted that the combination of Summers et al. and Harrow et al. would not result in the claimed invention.

Applicant submits that Examiner has not made a *prima facie* case of obviousness. The teaching or suggestion to make the claimed combination must be found in the prior art, not in Applicant's disclosure (*In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991). Applicant therefore submits that independent claims 1, 14, 24 are allowable and requests favorable reconsideration. Further, since Summers et al. and Harrow et al. do not anticipate or suggest claims 1, 14, 24 as discussed above, then dependent claims 2-11, 15-21, 25-33 are allowable as well. The Applicant respectfully traverses the objections of claims 1-11, 14-21, 24-33 and submits that the presently claimed invention is patently distinct over Summers et al. in view of Harrow et al. The Examiner is respectfully requested to withdraw the rejection based on § 103(a).

Claims 13, 23, 35:

The Examiner rejected claims 13, 23, 35 under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,181,258 ("Summers et al.") in view of U.S. Patent No. 5,754,437 ("Blazo").

In light of the amendments and arguments presented above in connection with independent claims 1, 14, 24, Applicant believes that dependent claims 13, 23, 35 overcome the Examiner's § 103(a) rejection based on the Summers et al. and Blazo references. The Examiner is respectfully requested to withdraw the rejection based on § 103(a).

<u>Claims 12, 22, 34:</u>

The Examiner rejected claims 12, 22, 34 under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,181,258 ("Summers et al.") in view of U.S. Patent No. 6,714,605 ("Sugar et al.").

In light of the amendments and arguments presented above in connection with independent claims 1, 14, 24, Applicant believes that dependent claims 12, 22, 34 overcome the Examiner's § 103(a) rejection based on the Summers et al. and Sugar et al. references. The Examiner is respectfully requested to withdraw the rejection based on § 103(a).

<u>Claims 1, 14:</u>

The Examiner rejected claims 1, 14 under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 7,203, 229 ("Ishida et al.") in view of U.S. Patent No. 7,046,792 ("Harrow et al."). Applicant has reviewed the cited art and respectfully submits that the art fails to disclose or suggest the Applicant's claimed invention, and fails to teach each and every element and limitation of the claims rejected herein. Specifically, Applicant respectfully submits that the prior art fails to disclose or suggest at least a method of **<u>estimating modulation noise</u>** that includes the steps of averaging phase error samples, generating a normalized phase error which is then compared to a threshold, and generating a failure indication if the number of threshold

crossings exceeds a maximum. Therefore, Applicant respectfully traverses the rejections and request favorable reconsideration.

Ishida et al. teaches an apparatus and method for measuring jitter in an RF signal. The signal under measurement is band-limited, and frequency components around a fundamental frequency of the signal under measurement are extracted. Waveform data (approximated zero-crossing data) close to zero-crossing timings of the band-limited signal are sampled, and phase error data between the approximated zero-crossing points and the corresponding zero-crossing points of the signal under measurement are calculated from the approximated zero-crossing data to obtain a zero-crossing phase error data sequence $\delta[k]$. An instantaneous period sequence T(k) of the signal under measurement is obtained from the zero-crossing phase error data and sampling intervals $T_{k,k+1}$ of the approximated zero-crossing data sequence. Then a period jitter sequence is obtained from differences between the T(k) and a fundamental period T_0 of the signal under measurement, and then the period jitter sequence is multiplied by $T_0 / T_{k,k+1}$ to correct the period jitter sequence.

It is submitted that the mechanism of Ishida et al. is operative to **measure jitter** by observing and measuring the zero crossings of the signal, apparently a high frequency RF signal on the order of gigahertz for wireless applications such as Bluetooth or cellular transceivers. Measuring the zero crossings and computing the resulting jitter at such high frequencies is a relatively difficult and costly task requiring expensive test equipment and complex circuitry to provide sufficiently fast enough measurements and processing resources.

In contrast, the mechanism of the present invention generates an **estimate of the modulation noise** that is derived from a related **low-frequency phase-error signal**, which is a

substantially different measurement that does **not** require direct processing of the high frequency RF signal generated by the oscillator, as is the case in Ishida et al..

Assuming the crystal reference output is sufficiently clean of phase noise, the phase error signal contains only a signal representing the RF oscillator noise, which is down-converted to **baseband**. The baseband phase error signal already effectively reflects the jitter/phase-noise by providing a measure of how much the RF oscillator instantaneously deviates from the desired center frequency. This is substantially different from the mechanism of Ishida et al. which operates on the zero crossings of the high frequency RF signal.

The mechanism of the present invention calculates the moving average of the baseband phase error signal and passes it through what operates substantially as a **high pass filter** (i.e. subtracting the average from the current sample is effectively a high pass filtering function) to generate a normalized phase error. This is then compared to a threshold to determine whether the instantaneous phase/frequency error exceeds the predefined limit. If the number of threshold crossings within a predetermined period of time exceeds a maximum, the part under test fails, otherwise it passes. Thus, the object and manner of the mechanism of the invention is substantially different than that of Ishida et al. These features are neither taught nor suggested by the Ishida et al. or Harrow et al. references.

Applicant respectfully submits that the Examiner has failed to show that one of ordinary skill in the art would have been motivated to modify Ishida et al. in view of Harrow et al. to arrive at the claimed invention because there is no suggestion made by Ishida et al. or Harrow et al. to perform **modulation noise measurements** in a transmitter by counting the number of times the normalized phase error within a PLL crosses a threshold. It is submitted that the

combination of Ishida et al. and Harrow et al. would not result in the claimed invention. The Examiner is respectfully requested to withdraw the rejection based on § 103(a).

Correction of Typographical Errors

Amendments haven been made to correct grammatical and usage errors in the specification. No new matter has been added to the application by these amendments.

Conclusion

In view of the above amendments and remarks, it is respectfully submitted that independent claims 1, 14, 24 and hence dependent claims 2-13, 15-23, 25-35 are now in condition for allowance. Prompt notice of allowance is respectfully solicited.

In light of the Amendments and the arguments set forth above, Applicant earnestly believes that they are entitled to a letters patent, and respectively solicit the Examiner to expedite prosecution of this patent applications to issuance. Should the Examiner have any questions, the Examiner is encouraged to telephone the undersigned.

Customer Number: 23494

Respectfully submitted,

ZARETSKY & ASSOCIATES PC

By: Howard Zaretsky

Howard Zaretsky
Reg. No. 38,669
Attorney for Applicants

Texas Instruments Incorporated
7839 Churchill Way, MS 3999
Dallas TX 75251
Tel.: 623-362-2585